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Preliminary Study on the Systematic Status of a Danjo Islands Snake

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ABSTRACT : The snake found on Oshima Is., Danjo Islands, has been treated as *Natrix sauteri* without sufficient discussion. However, this Danjo Islands snake is different from *Amphiesma* (formerly *Natrix*) *sauteri* in the dorsal scale rows formation, an important character in the genus, and very similar to *A. vibakari* in this character. Therefore, this snake is described as a new subspecies, *Amphiesma vibakari danjoensis*. The new subspecies is restricted to Oshima Is., Danjo Islands, Japan and characterized by lower ventral count, higher subcaudal count and higher tail ratio than in the other two subspecies of *A. vibakari*. Further, it shows unique features not seen in other forms of the *A. vibakari* group (*sensu* Malnate, including *A. vibakari*, *A. sauteri* and *A. popei*). The internasorostral contact ratio is about 0.5, far smaller than that of the others. Prefrontals have narrow contact with supraoculars. Postoculars are relatively reduced and usually three among seven supralabials enter the orbit.

INTRODUCTION

The Danjo Islands are situated in the eastern part of the East China Sea, 170 km west of Kyushu Is. (Fig. 1). The islands are composed of five small islands and a lot of rocks, of which the largest one is Oshima Is., 2.81 km^2 in area. Several specimens of a small natricine snake were found in this island and reported as *Natrix vibakari* by Katō et al. (1968), although they noticed a lower ventral count in these specimens than that of *N. vibakari* in the Japanese main islands. In the next survey, additional specimens were collected and reported as *Natrix sauteri* by Urata and Yamaguchi (1973) on the basis of the ventral count. Although their treatment was apparently not a definitive one, no works concerning the taxonomic status of this snake have appeared. This caused some workers interested in the zoogeography of the Danjo Islands to consider the snake as a relict of continental fauna in those islands (Yamamoto and Uozumi, 1981). To clarify the systematic status of this Danjo Islands snake, the present study was undertaken.

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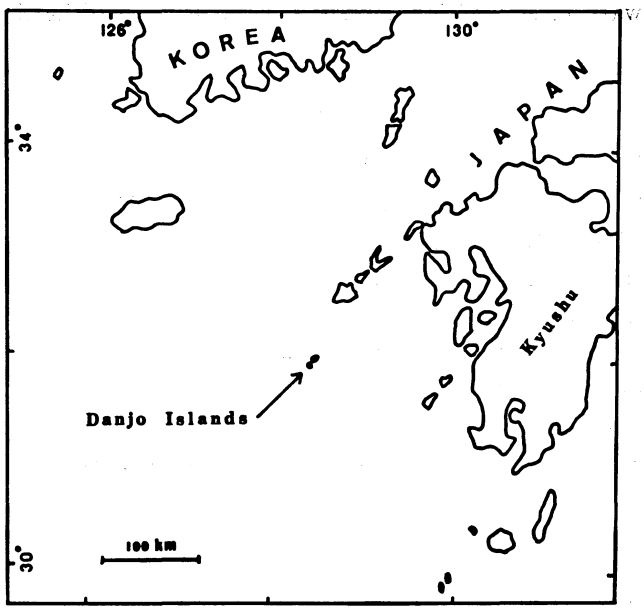

Fig. 1. Map of the northeastern portion of the East China Sea, indicating the position of the Danjo Islands.

MATERIALS AND METHODS

Five specimens of the snakes from Oshima Is., Danjo Islands, were available for the morphological study from Osaka Museum of Natural History (OMNH), National Science Museum, Tokyo (NSMT), and Nagasaki University (NU). The two unnumbered specimens from NU are referred to as NU-A and NU-B in the following account. The data obtained from these specimens were compared with literature records, especially with the detailed work on some *Amphiesma* species by Malnate (1962), and supplemented by my own observations on parts of the collections of *Amphiesma* species in Japan Snake Institute (JFS) and Chengdu Institute of Biology, Academia Sinica, People's Republic of China (CIB). A specimen of *A. vibakari* from Yakushima Is. was lent by Mr. Hidetoshi Ota, Kyoto University.

In the following account, ventral counts are given in wider than long system for comparison with literature records. Those in Dowling's system are mentioned in the notation to Table 1. The internasorostral contact ratio as defined by Malnate (1960, 1962) means the ratio of the contact between rostral and an internasal to that between rostral and adjacent nasal. The maturity of the specimens of the Danjo Islands snake was not checked from the condition of the gonads, because most characters mentioned in this account do not change with growth in *Amphiesma viba-*

kari. The sex was determined by the presence or absence of hemipenes.

RESULTS

The snake from Oshima Is., Danjo Islands, had features fairly distinct from the forms of *Amphiesma vibakari* species group (*sensu* Malnate, including *A. vibakari*, *A. sauteri* and *A. popei*), to which it also belongs. However, it shows some diagnostic characters of *A. vibakari*, and was considered as a specialized form of *A. vibakari*. Therefore, the snake is here treated as a new subspecies of *A. vibakari*:

Amphiesma vibakari ***danjoensis*** subsp. nov.

Natrix vibakari (not of Boie) Kato *et al.* 1968. Reports of the cultural properties, Nagasaki Pref., no. 6, p. 68.

Natrix sauteri (not of Boulenger) Urata and Yamaguchi 1973. Fauna and flora of Danjo Islands, p. 55.

Holotype: OMNH R-2098, a male collected under a decayed piece of wood at Kochidomari, Oshima Is. by Hiroshi Minato on 6 Aug. 1972.

Paratypes: OMNH R-2097, a male collected with the holotype; NSMT H-00549, a male collected at Oshima Is. by Shin-ichi Morita on 30 Jul. 1967.

Referred specimens: NU-A and NU-B, a female and a male collected at Oshima Is. by Tetsuo Yamaguchi on 30 Jul. 1967.

Diagnosis: A subspecies of *Amphiesma vibakari* with 129–134 ventrals in both sexes and 88–89 subcaudals in males; tail ratio 0.30–0.33 in males; internasorostral contact ratio about 0.5, far smaller than one; prefrontals make contact narrowly with supraoculars; postoculars usually two, the lower one being smaller; supralabials seven, 3rd to 5th, occasionally 3rd and 4th, entering orbit; dorsal scales keeled in all rows; known only from Oshima Is., Danjo Islands, Japan.

Description of the holotype: Snout-vent length 174 mm, tail length 78 mm, total length 252 mm; tail ratio (ratio of tail length to total length) 0.31; rostral wider than high, feebly visible from above; snout slightly narrow; internasals as long as wide, tapering anteriorly; internasorostral contact ratio 0.53; prefrontals longer than internasals, wider than long, narrowly making contact with supraoculars, the contact not so broad as in other forms of the *vibakari* group; frontal 1.2 times longer than wide, longer than its distance from tip of snout, slightly shorter than interparietal suture; parietals shorter than their combined width, truncate at their posterior border; supraoculars 1.8 times longer than wide; nasals divided, the nostril not small, situated at the border of two plates; loreal slightly longer than high; preoculars single; postoculars two, lower one smaller than upper one; anterior temporals single, posterior temporals also single and separated from the anterior one

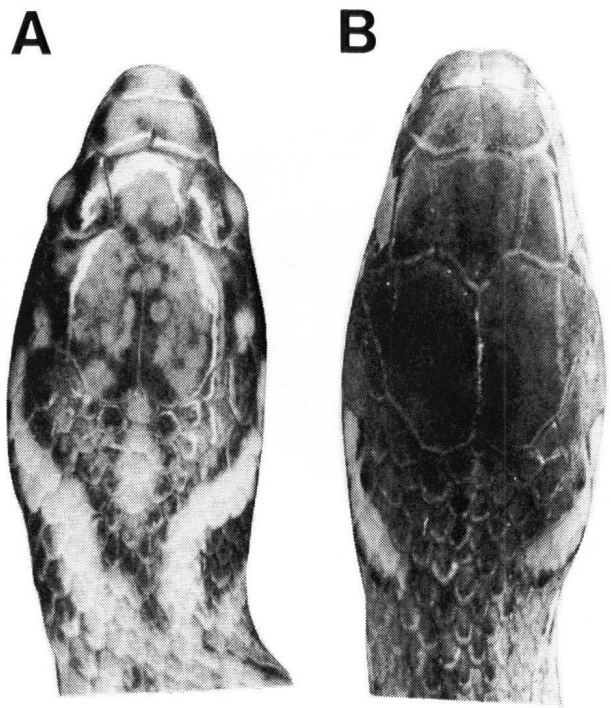

Fig. 2. Dorsal view of heads of (A) *Amphiesma vibakari danjoensis* (OMNH R-2098) and (B) *A.v. vibakari* (JFS-2710) from Kitakyushu, Kyushu. Black bars equal to 5 mm.

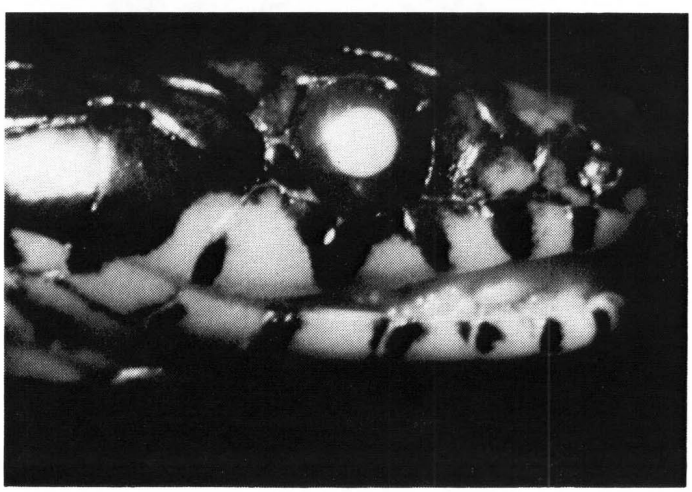

Fig. 3. Lateral view of head of *Amphiesma v. danjoensis* (NSMT H-00549). Note the small lower postocular.

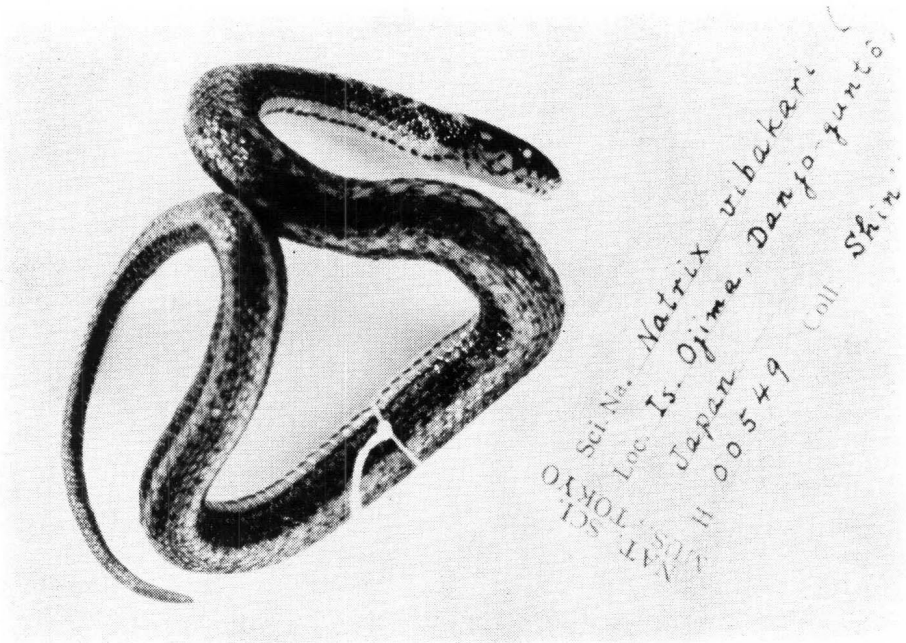

Fig. 4. Dorsal view of a specimen of *Amphiesma v. danjoensis* (NSMT H-00549).

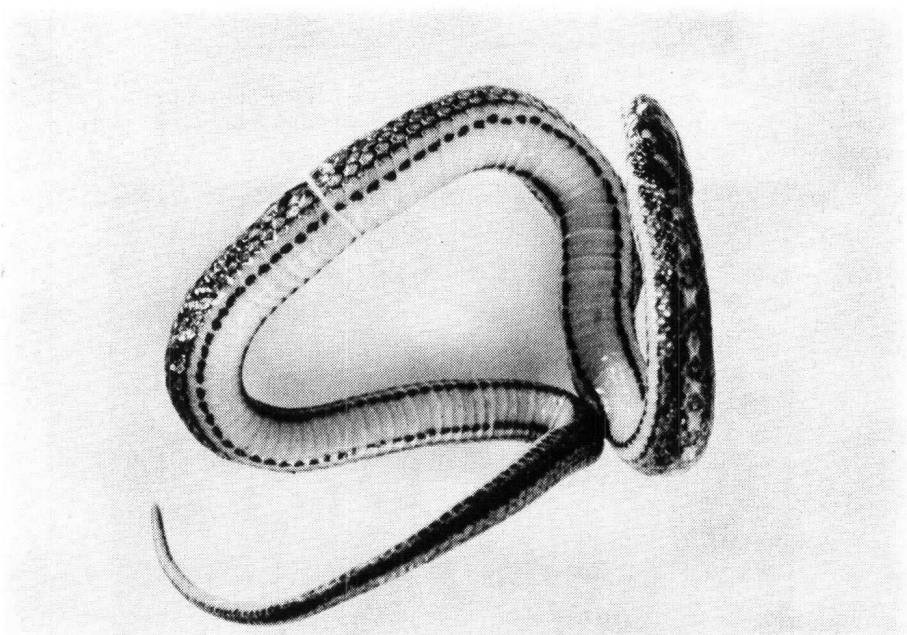

Fig. 5. Ventral view of *Amphiesma v. danjoensis* (NSMT H-00549).

by the contact of the 6th supralabial with the parietal.

Supralabials 7, the 3rd to 5th entering the orbit; the 6th largest and in contact with parietals; posterior supralabials slightly raised, the suture between the 5th and 6th directed anterodorsally and the line dorsally extended from this suture touching the eye; infralabials 8, the first 4 bordering the anterior chin shields, the 5th largest; posterior chin shields longer than the anterior pair, slightly in contact with each other, separated by small gular scales in most of the length.

Dorsal scale row formula $19\frac{3+4(70)}{3+4(73)}17(131)$, the scale row reduction at 0.56 in ventral ratio from the 1st ventral; dorsal scales keeled in all rows, the carination in the outer one or two rows weak ; apical scale pits feebly visible at neck region; ventrals 131 by wider than long system, 129 by Dowling's system; anal divided; subcaudals 89, the 2nd to 8th, 10th to 14th, 19th and 20th single, others paired.

Coloration (holotype in alcohol, slightly discolored): Dorsum whitish brown with four longitudinal rows of brown spots; the spots in outer rows larger than those of inner rows, on the 3rd scale rows, sometimes extending to adjacent rows, at intervals of one scale length ; the spots in inner rows on the 8th (7th after scale row reduction) scale rows at intervals of one and a half to two scale lengths; two rows of light spots on the 6th and adjacent rows at intervals of one to one and a half scale lengths; head dark brown above, slightly lighter on the inner area of each head shield; mid-dorsal light bar just after the parietals; a light spot on the temporal region; supralabials whitish, the sutures of the anterior four, and between the 5th and 6th with narrow dark edges ; on the suture of the 4th and 5th, a dark reverse triangular marking extending from lower edge of eye; the light area of the last supralabial separated from that of anterior part by the extension of dark dorsal area to the labial margin at the region of the 6th to 7th supralabials; from the light area of the last labial at the corner of the mouth, a light nuchal band extends diagonally upward and backward over the nape, turning posteriorly and continued for a short distance on the side of the neck along the mid-dorsal line; somewhat posterior to this nuchal band, another light nuchal band originating at the 4th and 5th ventrals, extending diagonally toward the 1st light spot on the dorso-lateral light stripe; infralabials whitish, narrowly edged with brown at the sutures; ventral head grayish white with some brown spots on the chin shields and gulars; venter grayish white with a row of brown spots or dashes along both sides of ventral plates and subcaudals.

Hemipenis (NSMT H-00549): The hemipenis undivided, extending to the 8th subcaudals; spinous throughout with a relatively large spine; the sulcus spermaticus

single (the condition at the tip ambiguous).

Dentition (left maxilla of NU-B): 21 in continuous series, increasing in size posteriorly, the last one largest.

Variation: The meristic characters of the specimens examined are shown in Table 1. Snout-vent length varies from 126 to 179 mm. Two specimens had an incomplete tail, and the subcaudal count and tail ratio were obtained only from three males. Ventrals are 127–134 in males, 130 in a female, and subcaudals are 88–89. Tail ratio is 0.30–0.33. Dorsal scale rows are 17 throughout the body in one specimen, and others have 19–17 rows with the reduction at 3rd and 4th row region. The ratio of ventrals at which scale row reduction occurs to the total ventrals is 0.46–0.58,

Table 1. Main characters of five specimens of *Amphiesma vibakari danjoensis*.

Specimen No.	NSMT H-00549	OMNH R-2097	OMNH R-2098	NU B	NU A
Sex	♂	♂	♂	♂	♀
S.-V. length[1]	179	126	174	173	172
Tail length[1]	—	55	78	87	—
Tail ratio	—	0.30	0.31	0.33	—
Ventrals[2]	130	134	131	127	130
Subcaudals	70+	88	89	88	72+
Single subc.	1-3	2-6	2-8 10-14 19-20	—	—
Scale rows	19-17	17-17	19-17	19-17	19-17
Reduction[3]	75-74	—	73-70	51-59	63-60
Ratio at reduction point[4]	57.7	—	55.7	45.7	48.5
Supralabials	2+3+2	2+2+3	2+3+2	2+3+2	2+2+3
Infralabials	8	8	8	8	8
Preoculars	2-1	1	1	1	2
Postoculars	2	2	2	2	1-2
Temporals : l.	1+2	1+1+2	1+0+1	1+1+2	1+1+2
r.	1+1+2	1+1+2	1+0+1	1+1+2	1+1+1

1) S.-V. and tail length are given in mm.
2) Ventral count is that of wider than long system. That of Dowling's system is two ventrals less than the fromer system in all specimens except R-2097 in which three ventrals less.
3) Reduction indicates scale reduction point, and is expressed by the ventral number at which scale reduction occurs.
4) Ratio of reduction point is the percentage of ventrals before reduction to total ventrals, where the posterior reduction point between both sides is used.

which indicates that the reduction occurs at mid-body region. Supralabials are 7 in all specimens; three labials enter the orbit in three specimens, and two labials in two specimens. Postoculars are two in most cases ; the size of lower one is reduced in general, and the extreme case is the single postocular in a female specimen where the area usually covered by the lower postocular is only partially covered by the postocular and interstitial skin separates the 5th supralabial from the eye. The occurrence of single subcaudals at the base of the tail is seen in three specimens. In all specimens except NU-B, dorsal scales are keeled in all rows and apical pits are not clear. NU-B was slightly desicated and it was difficult to observe these condition accurately. The coloration of specimen NSMT H-00549 is best preserved among the specimens examined. The rows of light spots become a light longitudinal stripe in this specimen.

Habit and habitat: Oshima Is. is like a table in appearance, surrounded by cliffs, and the altitude of the highest point is 217 m. The island is covered by dense forest, evergreen forest of *Machilus thunbergii-Colysis pothifolia* community above the altitude of 150 m and scrub of *Ardisia sieboldii-Euonymus japonicus* community below that level (Toyama et al., 1968). The snakes were collected crawling on the dead leaves, or under decayed wood in the forest (Katō et al., 1968; Urata and Yamaguchi, 1973). The natural feeding habits of the snake are unknown, but Urata and Yamaguchi reported that a snake was successfully fed with the earthworm, *Pheletima communissima*, in captivity. A small gecko was also accepted by this snake. The island is poor in fauna, and two rodents, a skink, a gecko and this snake are the only known terrestrial vertebrate species. Small streams in the island have no freshwater fishes except an eel, *Anguilla marmorata*, which lives in some pools of the streams (Dotsu, 1973). An earthworm, *Pheletima servinus*, is known from the island (Katō *et al.*, 1968).

DISCUSSION

Before discussing the specific status of this Danjo Islands snake, the generic problem of the *vibakari* group should be mentioned briefly. As a generic name of the species *vibakari* both *Amphiesma* and *Natrix* are used in Japan. The former is used mainly by current herpetologists and the latter by other workers. However, there has been no discussion on this matter in Japan after the work by Nakamura and Uéno (1963), which has been used as a standard guide to the Japanese amphibians and reptiles. Therefore it would be appropriate to comment on this matter here.

After Malnate (1960) divided the genus *Natrix* into five genera, McDowell (1961) pointed out the ambiguous nature of *Amphiesma* and *Natrix* (*sensu* Malnate), and

suggested two courses to be taken by subsequent workers. He stated, "Either "*Amphiesma*" and *Natrix sensu* Malnate should each be further split or the two combined. My own guess is that the former course will prove more satisfactory, ..." Nakamura and Uéno (1963) selected the latter course and used the name *Natrix* for *vibakari* and *pryeri*. However, most other workers took the former course as suggested by McDowell. *Natrix* (*sensu* Malnate) was divided into four genera by Rossman and Eberle (1977) based on a more comprehensive study than the previous works. Thus the genus *Natrix* was clearly defined by them from karyotype, skull, hemipenial and scale characters. The genus includes only three European species at present. On the other hand, the Australasian species group of the genus *Amphiesma* has been separated from *Amphiesma* (McDowell, 1984). I agree with the workers who took the former course and consider that the recognition of the genus *Natrix* in the sense of Nakamura and Uéno will obscure the relationships of the species in the genus and related genera. Therefore, the *vibakari* group is placed in the genus *Amphiesma* in the present study. However, *Amphiesma* (*sensu stricto*) seems not to form a natural group and needs a revision. The differences in karyotypes and hemipenial morphology between the *vibakari* group and *A. stolata*, type species of *Amphiesma* (Singh, 1972; Zhang et al., 1984) suggest their polyphyletic origin and the generic name of the *vibakari* group may be further changed in future.

Most of the morphological characters of *danjoensis* except the internasorostral contact ratio and some other features mentioned later agree well with those of the *Amphiema vibakari* species group in the sense of Malnate (1962). Among the three species in this group, *vibakari* and *sauteri* are similar to *danjoensis* in having 7 subrabials. Of these two species, *vibakari* is similar to *danjoensis* in dorsal scale rows, whereas *sauteri* resembles the latter in ventral and subcaudal counts (Table 2). It has been said that the ventral or subcaudal count of insular snake populations tends to increase compared with that of mainland populations (Mertens, 1934; Zweifel, 1960). This indicates the variability of these characters in an isolated population under particular physical conditions. On the other hand, 17 scale rows throughout the body of *sauteri* is a unique character in the genus *Amphiesma*, and is shared only by *A. atemporalis*. I found two exceptional specimens of *sauteri* from Fujian (CIB 64 II 115244) and Hunan (CIB 75 I 5230) whose scale rows were $17\frac{x}{1+2(92)}15$ (133) and $15\frac{+4(33)}{+4(39)}$ 17(133), respectively (x means that the reduction site was not examined). Although one of the specimens of *danjoensis* has scale rows similar to *sauteri*, such a variation is known in *A. vibakari ruthveni* in China (Zhejiang Medical Univ. *et al.*, 1980). The data on the ventral counts and dorsal scale rows presented by Urata and Yamaguchi (1973) are not quoted here. For the ventral count, the method they used is not clear. For the dorsal scale rows, they made a count probably at the mid-body

Table 2. A comparison of the number of ventrals and subcaudals among the subspecies of *Amphiesma vibakari* and *A. sauteri*[1].

Subspecies	Sex	Ventrals	Subcaudals
A. v. vibakari	♂	145-153(25)	68-82(22)
		147.7	74.8
	♀	142-153(29)	62-78(23)
		146.7	70.3
A. v. ruthveni	♂	147-155(13)	58-69 (9)
		151.2	62.2
	♀	143-155(18)	54-68(14)
		147.6	58.9
A. v. danjoensis	♂	127-134 (4)	88-89 (3)
		130.5	88.3
	♀	130 (1)	
A. s. sauteri	♂	122-137(13)	71-92(10)
		128.7	81.2
	♀	120-135(21)	71-79(17)
		128.4	75.7
A. s. maximus	♂	135-139 (4)	68-83 (2)
		137	75.5
	♀	138-146 (4)	65-81 (3)
		141	74.7
A. s. bourreti	♂	123-129 (5)	65-74 (5)
		126.4	70.4
	♀	127-130 (2)	60 (1)
		128.5	

1) Although the data are quoted from the work of Malnate (1962) except *danjoensis*, the data on the subspecies of *A. sauteri* are modified with the addition of my own observation. In doing so, the specimens from Anhui and Hunan are included in *sauteri*, those from Guizhou are in *maximus* and that from Hainan Is. is in *bourreti*. The range and mean given with the number of specimens in parentheses.

region. However, the scale reduction occurs at this region as stated above, and the 17 scale rows recorded by them may have been obtained from the area caudal to the reduction. The 18 scale rows in one specimen they examined suggests that the count was made rostral to the reduction on one side and caudal to the reduction on the other side. Such a reduction at the mid-body region is also common in other subspecies of *A. vibakari* (Malnate, 1962). Therefore, the description by Nakamura and Uéno (1963), "Dorsal scale rows (of *vibakari*) are 19 in the neck region and most

of the body, 17 before anal, ... (translated from Japanese)", is incorrect.

As stated above, considering the dorsal scale rows as an important character, *danjoensis* should be related to *vibakari*, and this idea is supported by their close distribution.

The narrow contact of rostral with internasals and prefrontals with supraoculars are unique features of *danjoensis* and not seen in other species or subspecies of the *vibakari* group, although the conditions are seen in *Amphiesma stolata*. As stated above, *A. stolata* has some characters different from the *vibakari* group. Therefore, the similarity between *danjoensis* and *stolata* should be considered as a secondary similarity. The small value of internasorostral contact ratio is related to the dorsolateral position of the nostrils, which was regarded as an aquatic adaptation in the genus *Natrix* by Malnate (1960). However, neither *danjoensis* nor *stolata* is known to have aquatic habits (Pope, 1935). On the other hand, these two forms have different food habits from each other. The latter is a frog-eater and the former is probably an earthworm-eater. Therefore, different factors might have influenced the conditions of the snout of these two forms. Moriguchi and Naito (1982) examind the food contents of 26 specimens of *A. vibakari* at Yokohama, Japan, and found that 65% was frogs and their tadpoles, 19% loaches, and 16% earthworms. Because Oshima Is. has no amphibians or freshwater fishes except a large eel, the ancestors of *danjoensis* must have changed their food habits since they were isolated on the island. Such a change required more activity under dead leaves and may have affected the morphology of the snout.

In addition to the unique condition of the snout, the lateral region of the head has some modifications : the posterior portion of the supralabials is more raised and the postoculars slightly reduced. As a result, two postoculars are common and three labials enter the orbit at a high frequency. In other forms of the *vibakari* group, three postoculars are common and usually two labials enter the orbit.

The size of known specimens of *danjoensis* is very small, and their total length is less than 270 mm. Although the maturity of the specimens was not checked, they seem to be adult specimens. The small size of *danjoensis* may be related to the poor fauna of the island.

As discussed above, *danjoensis* has remarkable features different from other forms of the *vibakari* group, but has some features indicating relationship with *vibakari*. Therefore, it is considered a specialized form of *vibakari*. The possibility that *danjoensis* has evolved to the species level will be clarified in the future.

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要　　旨

男女群島のヘビの分類学的位置づけ

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男女群島男島で見られるヘビは，十分な分類学的検討がなされぬまま，ザウテルヘビ，*Natrix sauteri* としてあつかわれる事が多い。本研究では5個体の標本について精査を行い，このヘビをダンジョヒバカリ，*Amphiesma vibakari danjoensis* として記載した。ヒバカリの他の亜種との違いは，腹板数が少ない，尾下板数が多い，尾率が大きいこと。ザウテルヘビとの違いは，体鱗列に減少があること。これらを含めたヒバカリ種群全体との違いとして，吻端板と鼻間板との接する部分が小さい，前額板と眼上板が接する部分も狭いという，*Amphiesma stolata* に似た特徴があげられる。また，眼後板が2枚しかなく，3枚の上唇板が目に接するというように，頭部の鱗板のようすも，独特なものである。